

Obstructive Sleep Apnea

Obstructive sleep apnea is a common sleep disorder involving recurrent partial or complete obstruction of the upper airway, characterized by episodes of breathing cessation during sleep lasting 10 or more seconds and accompanied by oxygen desaturation of $\geq 4\%$.

ANESTHETIC CONSIDERATIONS:

- Potential difficult airway and difficult BMV
 - Craniofacial abnormalities, large tongue, obesity, neck circumference >40cm
- Chronic arterial hypoxemia and hypercapnia
 - OHS
- Pulmonary hypertension
- Arrhythmias (AFib)
- Systemic HTN and LVH
- Increased sensitivity to CNS depressants and opioids
- Associated comorbidities: obesity, hypothyroidism, downs syndrome
- Polycythemia secondary to chronic hypoxemia

ANESTHETIC GOALS:

- Anticipate possible difficult airway and difficult BMV
- Minimize respiratory depressants and utilize short acting anesthetic agents
- Consider postoperative monitoring for early identification of postoperative complications
 - Modified criteria for PARR discharge
- Consider CPAP postoperatively

HISTORY

- Symptoms of sleep apnea
 - Snoring
 - Frequent waking during night
 - Daytime somnolence – sleepiness, concentration, memory deficits, falling asleep driving
 - Early morning headache
- STOP-BANG questionnaire as a screening tool

Symptom	Scoring
Snore loudly	High risk OSA: ≥ 3 symptoms
Tiredness during daytime	Low risk OSA: < 3 symptoms
Observed to stop breathing during sleep	
Pressure high (HTN)	Sensitivity
BMI > 35 kg/m ²	- 93% for mod OSA
Age > 50yrs	- 100% for severe OSA
Neck circumference > 40cm	Specificity
Gender male	- 43% for mod OSA
	- 37% for severe OSA

- Risk factors for sleep apnea
 - Demographic – male, middle age (> 50)
 - Obesity (BMI > 30; #1 risk factor), metabolic syndrome, GERD
 - Endocrine disorders (Type 2 DM, Cushing disease, acromegaly, hypothyroidism)
 - Connective tissue disorders (Marfan syndrome)
 - Congenital conditions (craniofacial deformities, Down syndrome, muscular dystrophy)
 - Tonsillar hypertrophy
 - Lifestyle – alcoholism, smoking
- Complications of sleep apnea (related to hypoxemia/hypercarbia)
 - HTN and LV failure
 - Acute myocardial ischemia/infarction
 - Arrhythmias
 - Pulmonary HTN and RV failure/cor pulmonale
 - CVA
- Tx of sleep apnea
 - Compliance with CPAP
 - Need for nocturnal O₂
 - Pt to bring CPAP machine to hospital
- Functional capacity
- Hx of difficult intubation

PHYSICAL

- Vital signs – HR, BP (HTN), RR, T, SpO₂ (<94% on room air red-flag for severe chronic OSA)
- CNS – drowsiness, poor concentration
- HEENT – tonsillar hypertrophy, craniofacial deformities, neck circumference >40cm (>16” women, >17” men)
- AW – retrognathia, macroglossia, MP score 3-4
- RESP – work of breathing during sleep, auscultation
- CVS – RV failure (JVP, RV heave, S3/4, peripheral edema, hepatomegaly, ascites)
- GI – obesity (BMI > 30 kg/m², waist circumference > 40 inches)

- Endo – features of hypothyroidism, acromegaly, Cushing’s
- Heme – features of polycythemia (plethora, clubbing, acrocyanosis)

INVESTIGATIONS

- CBC – polycythemia
- Lytes, Cr, urea, blood glucose, liver enzymes, TSH
- ABG – hypoxemia and hypercapnia (during apneic episodes)
- Overnight oximetry – screening
- Overnight sleep study (polysomnography) – gold standard
 - Determine presence and severity of OSA, determine level of CPAP required

American Academy of Sleep Medicine	US Medicare Guidelines	Canadian Thoracic Society Guidelines
- Sx of excessive daytime sleepiness <i>and</i> - AHI ≥ 10 Mild OSA: AHI 5 – 15 Moderate OSA: AHI 15 – 30 Severe OSA: AHI > 30	- AHI ≥ 15 <i>or</i> - AHI $\geq 5 + 2$ comorbidities	- Daytime somnolence or ≥ 2 other Sx of OSA (choking/gasping during sleep, recurrent awakenings, unrefreshing sleep, daytime fatigue, impaired concentration) <i>and</i> - AHI ≥ 5

- See Pathophysiology section for definitions

- EKG – RV strain
- CXR – cardiomegaly
- +/- PFTs – consider
- +/- Echo – if suspect CHF or pulmonary HTN

OPTIMIZATION

- Defer major elective surgery in patients with high clinical suspicion of severe OSA with systemic complications
 - Note: high false-positive rate of screening questionnaires
- Consults
 - Respiratory/sleep medicine
- Conservative measures
 - Weight loss, avoid EtOH before bed, sleep on side
- Nocturnal CPAP (+/- O₂) most effective, improves neuropsychiatric function
 - Indicated for moderate to severe OSA
- Oral appliances may benefit mild OSA
- Medications ineffective (protriptyline, fluoxetine)
- Surgical
 - Tracheostomy for patients with severe OSA who cannot tolerate CPAP
 - Uvulopalatopharyngoplasty – efficacy questionable
 - Genioglossal advancement
 - Maxillomandibular advancement
- Benefits of preop Tx of OSA
 - Improve sleep in postop period, improve response to analgesic/anesthetic drugs, normalize CV disturbances
- Premedication
 - Sedatives
 - Avoid benzodiazepines and opioids
 - -agonists may ↓ intraop anesthetic requirements and have opioid-sparing effect
 - Anti-reflux prophylaxis as indicated

ANESTHETIC OPTIONS

- Order of preference: local > regional block > neuraxial > GA/ETT
- Local
 - Ideal as primary technique or adjunct for reducing opioid requirements
- Regional
 - Ideal as primary technique
 - Caution with neuraxial opioids – associated with greater than expected degree of ventilatory depression
 - Avoid concurrent sedation
 - Consider in combination with GA to allow effective non-opioid intra/post-operative analgesia
- General
 - Use short-acting agents (remifentanyl, propofol, desflurane)

ANESTHETIC SETUP

- **Drugs**
 - Short-acting sedatives/opioids/inhalational agents
 - Non-opioid agents for multimodal analgesia (local anesthesia infiltration, regional blocks, NSAIDs, acetaminophen, ketamine, gabapentin, pregabalin, clonidine, dexmedetomidine, dexamethasone)
- **Equipment**
 - CAS monitors + 5 lead EKG, consider artline
 - Capnography for sedation cases
 - Difficult airway cart
 - CPAP machine for postop

MANAGEMENT OF ANESTHESIA

- **Induction**
 - Full preoxygenation (+/- CPAP), positioning (sniffing, ramp)
 - Consider need for awake intubation vs RSI
 - Modify induction doses for obesity (see obesity seminar)
- **Maintenance**
 - Avoid N₂O in patients with pulmonary HTN
 - Avoid/minimize opioids and sedatives (respiratory depression, relaxation of pharyngeal dilator muscles)
 - Use short-acting iv anesthetic agents and insoluble potent inhalational agents (eg: desflurane)
 - More blood flow to increased fat burden → ↑ uptake of fat-soluble anesthetics
- **Emergence**
 - Ensure complete reversal of NMBAs
 - Extubate under controlled conditions once fully conscious with intact upper airway reflexes and in upright position
 - May require nasopharyngeal airway and CPAP postop
 - Following upper airway procedures – risk of worsening upper airway obstruction in early postop period due to surgically-induced edema + residual anesthetic drugs
 - Consider ICU admission for delayed extubation and monitoring

DISPOSITION & MONITORING

- **Analgesia**
 - NSAIDs beneficial, avoid/minimize opioids
- **Oxygenation**
 - Maintain SpO₂ > 90%
- **Positioning**
 - Upright/sitting position
- **Monitoring**
 - Risk of residual respiratory depression and hypoxemia post-GA
 - Early: first 24 hrs
 - Late: 2-5 days
 - Monitor for longer period in PARR
 - For suspected or confirmed OSA: 30-60min beyond meeting modified Aldrete criteria for discharge
 - For ambulatory OSA patients: 3hrs longer than non-OSA patients, or 7hrs following episode of apnea or airway obstruction
 - Monitor adequacy of ventilation
 - Continuous oximetry (O₂ desaturation), observation (apneic episodes)
 - Monitor for arrhythmias/ischemia
 - Continuous EKG
- **Special**
 - May require CPAP
- **Disposition**
 - Depends on age, severity of OSA, status of OSA (treated/untreated), comorbidities, type of surgery, anesthetic agents administered, supervision at home
 - May consider for ambulatory surgery
 - Superficial surgery/minor orthopedic procedures under local/regional anesthesia, lithotripsy
 - No requirement for high-dose opioids
 - Transfer to inpatient facility available
 - Postop monitored bed (continuous oximetry + possibility of early nursing intervention) if:
 - Severe OSA, major surgery, airway surgery
 - Respiratory event observed in PARR during 2 separate 30 minute time periods
 - One respiratory event consists of:
 - Apnea ≥10 sec (1 episode)
 - Bradypnea RR < 8/min (3 episodes)
 - Desaturation to < 90% with nasal cannula (3 episodes)
 - Pain-sedation mismatch
 - Patients with severe OSA and recurrent respiratory events in PARR are at ↑ risk postop respiratory complications and may also require CPAP
 - Duration of postop monitoring
 - AHI worsens postop, with peak on night 3 and return to baseline on night 7
 - Monitoring overnight may not safeguard against all respiratory events in first postop week
 - Current recommendations
 - 24 – 48 hrs
 - Until room air SpO₂ >90% during sleep

COMPLICATIONS

- **Respiratory**
 - Failed intubation
 - Post-extubation airway obstruction
 - Postoperative respiratory depression/arrest
 - Postoperative pneumonia
- **Cardiac**

- Arrhythmias
- Worsening pulmonary HTN and RV failure
- Cardiac arrest

OBSTETRICS

- Physiologic changes affecting OSA
 - Promote OSA
 - Estrogen → mucosal hyperemia and edema of upper airways → narrowing of upper airways
 - Weight gain of pregnancy with baseline obesity
 - Protect against OSA
 - Progesterone ↑s pharyngeal muscle tone and minute ventilation
 - ↓REM sleep
- Impact of OSA in pregnancy
 - ↓FRC, ↑O₂ consumption → more rapid O₂ desaturation with apnea/hypopnea
 - Recurrent hypoxemic episodes may adversely affect fetus – IUGR
 - ?Contribution of OSA to preeclampsia
- Suspect undiagnosed OSA in obese parturients
- Diagnosis and management as for non-obstetric patients with OSA
- Avoid opioids in epidural solutions
 - For c-section consider other supplemental regional analgesic techniques (local anesthetic infiltration, continuous incisional infusion of local anesthetic, ilioinguinal nerve block)
- Careful monitoring for postoperative hypoxemia following discharge from PARR

PATHOPHYSIOLOGY

- **Epidemiology**
 - Incidence 1 in 4 men; 1 in 10 women
 - Moderate-severe OSA 11.4% of men, 4.7% of women
- **Definitions**
 - Obstructive apnea – total cessation of airflow for ≥10 seconds despite continued ventilatory effort, resulting in oxyHb desaturation of ≥4%
 - OSA – ≥4 apnea episodes per hour of sleep
 - Obstructive hypopnea – 30-50% reduction in airflow for ≥10 seconds; O₂ desaturation may occur
 - Airway resistance – snoring without frank apnea or hypopnea; no oxyHb desaturation
 - Apnea-hypopnea index (AHI) – the number of abnormal respiratory events per hour of sleep
- **Pathophysiologic features**
 - Pharyngeal patency depends on pharyngeal dilator muscle tone
 - ↓Muscle tone during sleep (esp REM), sedation/GA, alcohol
 - Patency of collapsible pharynx determined by difference between extraluminal and intraluminal pressures
 - Fat mass in obesity ↑s extraluminal and ↓s intraluminal pressure → ↓ caliber of upper airway
 - Diaphragm contraction with inspiration → negative pressure within airways → narrowing of collapsible pharynx due to lack of bony support
 - ↓Pharyngeal dilator muscle tone (sleep) + obesity → significant narrowing of upper airway → ↑airway resistance → turbulent airflow → snoring
 - Upper airway obstruction during sleep → ↑inspiratory effort + hypoxemia/hypercarbia → arousal → upper airway tone restored → return to sleep → repeat cycle
 - Blunted physiologic responses to hypoxemia and hypercapnia
 - Consequences of hypoxemia/hypercarbia
 - Arrhythmias
 - SNS activation
 - ↑SVR → HTN
 - ↑Proinflammatory cytokines and oxidative stress → metabolic syndrome, HTN
 - Pulmonary HTN
 - Myocardial ischemia
 - Cerebral ischemia
 - Cerebral vasodilation → morning headaches
- **Obesity hypoventilation syndrome**
 - Consequence of long-term untreated OSA
 - Nocturnal alterations in control of respiration, manifesting as central apneic events (desensitization of respiratory centers to nocturnal hypercarbia)
 - Extreme culmination – Pickwickian syndrome: daytime hypersomnolence, arterial hypoxemia, polycythemia, hypercarbia, respiratory acidosis, pulmonary hypertension and RV failure

REFERENCES

- Anesthesia and Coexisting Disease p. 299-301
- Miller p. 1040-41, 2092-93
- Barash p. 1232-33
- Chestnut p. 1088-89
- Obstructive sleep apnea: preoperative assessment. Anesth Clinics 2010; 28:199-215
- Perioperative management of patients with obstructive sleep apnea. Anesthesiology 2006;104:1081-93
- Sleep disorders in pregnancy. Curr Opin Pulm Med 2003;9:477-83